

# December 2004 NC Weather Review

## Overview

December 2004 was a month of highly variable weather conditions. Although the statewide average monthly temperatures and precipitation will go down in the record books as being “slightly below normal”, the state experienced everything from thunderstorms and flash flooding, to near record warmth, record cold, snow, ice, and biting wind chills at some point during the month. When experienced, these conditions felt anything but “normal”. It was only when all the data during the 31 days of December was averaged together that it appeared to be a “near normal” month.

December 2004 started fairly mild and calm, but turned briefly wet and stormy during the second week of the month. A bout of strong thunderstorms with frequent lightning, very heavy rain, and gusty winds affected many areas during the early morning hours of December 10, 2004. These thunderstorms were associated with the approach of a strong upper level trough that would introduce much colder air to the state. A colder than normal pattern then prevailed through much of the last half of December. Weather pattern changes from warm to cold are sometimes accompanied by unusual or severe weather, even in winter. When these pattern changes occur in winter, they can be often associated with winter storms producing snow and ice. That is exactly what transpired in December 2004.

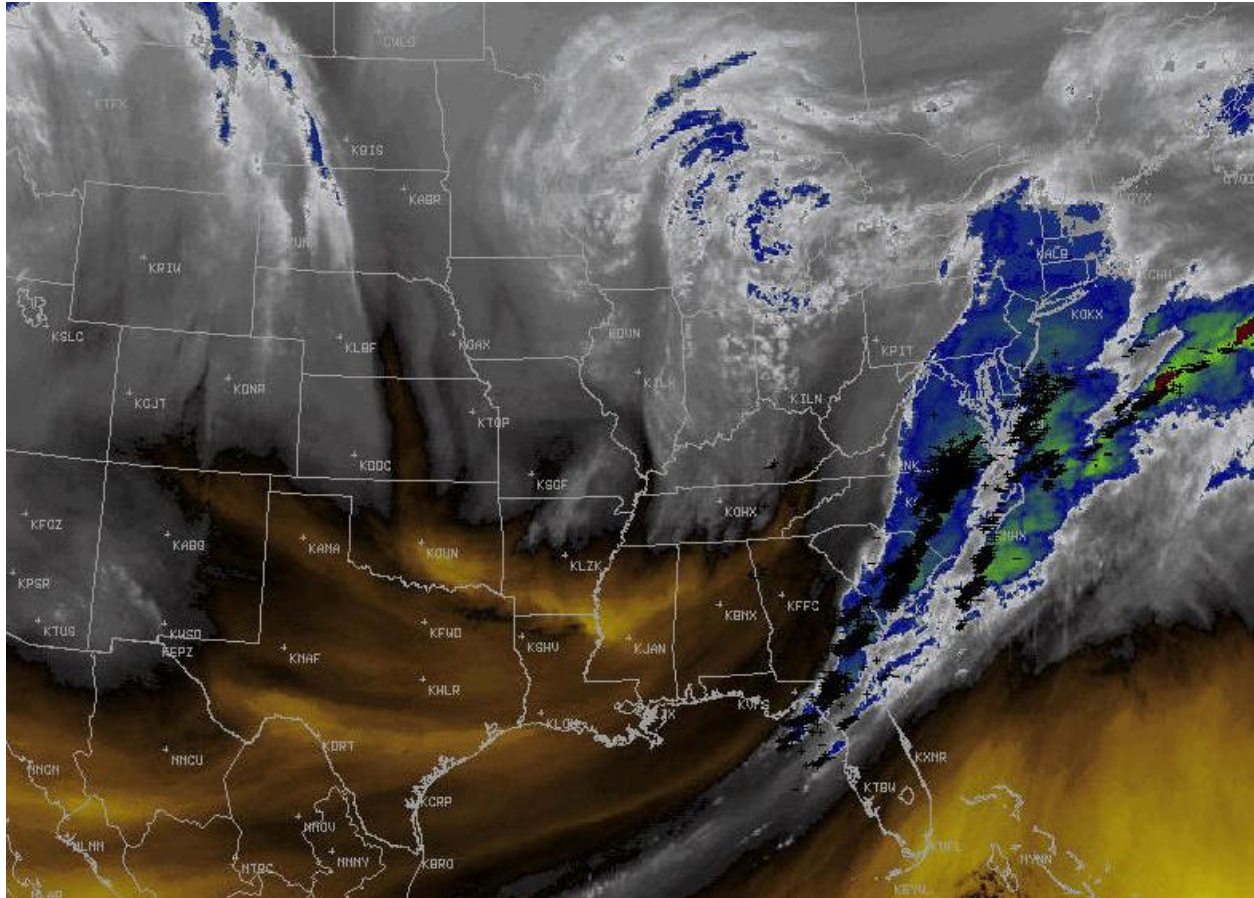
These winter storms, which brought measurable snow and ice to unusual places, left many areas that typically get winter weather unaffected. However, the cold snaps affected all areas of the state. Then, in what seemed like a flip of a switch, the cold flow from the north was shut off. It was replaced by an unusually warm southwesterly flow that sent many temperatures surging to near 70 on December 30 and 31.

## Details

### Thunderstorms followed by cold weather near mid month

A bout of strong thunderstorms with frequent lightning, very heavy rain, and gusty winds affected many areas during the early morning hours of December 10, 2004. Isolated severe weather was reported with hail the size of pennies observed near Roxboro, and lightning damage to several houses in the Winston-Salem and Greensboro areas. Flash Flooding was also observed over portions of the northern Piedmont. Rainfall with these storms totaled up to 1 to 3 inches in some locations.

Thunderstorms in December are generally an unusual occurrence. Figure 1 is a Water Vapor Image captured at 645 AM, on December 10<sup>th</sup>, 2004. The clusters of black dots noted across North Carolina are lightning strikes that were detected during the hour, between 600 AM and 700 AM EDT. The lightning strikes were associated with a large scale region of enhanced moisture and lift (depicted best by the enhanced colors of blue and yellow - indicating that the clouds extended well up into the atmosphere, perhaps as high as 50,000 feet). In addition to the frequent lightning, 1 to 3 inches of rain and wind gusts up to 40 MPH occurred.



**Figure 1: Water Vapor Satellite Imagery from early on December 10, 2004 depicting a strong mid and upper level trough moving across North Carolina. Strong to isolated severe thunderstorms occurred with the passage of this trough. These thunderstorms marked the beginning of a pattern change across the eastern United States from a warm ridge to a cold trough. Only ten days later, portions of North Carolina experienced the first snowfall of the season and nearly all of the state shivered in the coldest weather it has experienced in nearly 10 years.**

## Winter Storms during December 2004

Colder and drier weather followed the noisy thunderstorms that occurred on December 10<sup>th</sup>. It appeared that the state would not experience any wintry precipitation until a strong trough pushed the coldest air of the season into North Carolina on December 19<sup>th</sup>. Cold arctic air rushed into the state on the 19<sup>th</sup> producing snow across the favored western and northern facing slopes of the mountains. Arctic boundaries not only bring very cold air deep into the southeast, they can occasionally produce accumulating snow in unusual places. Although many of the larger cities including Charlotte, Winston-Salem, Greensboro, and Raleigh were spared of any snow this time, the arctic boundary did not disappoint snow lovers in “down east” North Carolina.

As the very cold arctic air surged toward the coast, it combined with moisture from a weak low pressure system approaching from the northeast Gulf of Mexico to produce snow. The snow accumulated from 2 to 4 inches in an area extending from Greenville northeast to near Edenton and Elizabeth City. Snow accumulations of 1 to 2 inches were reported on the Outer Banks. Snow accumulations are a rare occurrence on the Outer Banks, occurring only once every 10 years on average. The snow was generally confined to eastern North Carolina in locations that typically do not see much snow. Areas to the west were left out of this event and had to endure the coldest air of the season with no snow cover.

Figure 2 is a snowfall map from the storm on December 19<sup>th</sup> and 20<sup>th</sup>, 2004. The snow over the mountains was associated with the cold air and moisture that was forced up the western and northern slopes of the mountains producing “upslope snow”. Only flurries were reported across the eastern slopes of the Blue Ridge. The snow across “down east” North Carolina was produced by the surge of arctic air from the north, combined with a weak low pressure system approaching from the southwest.

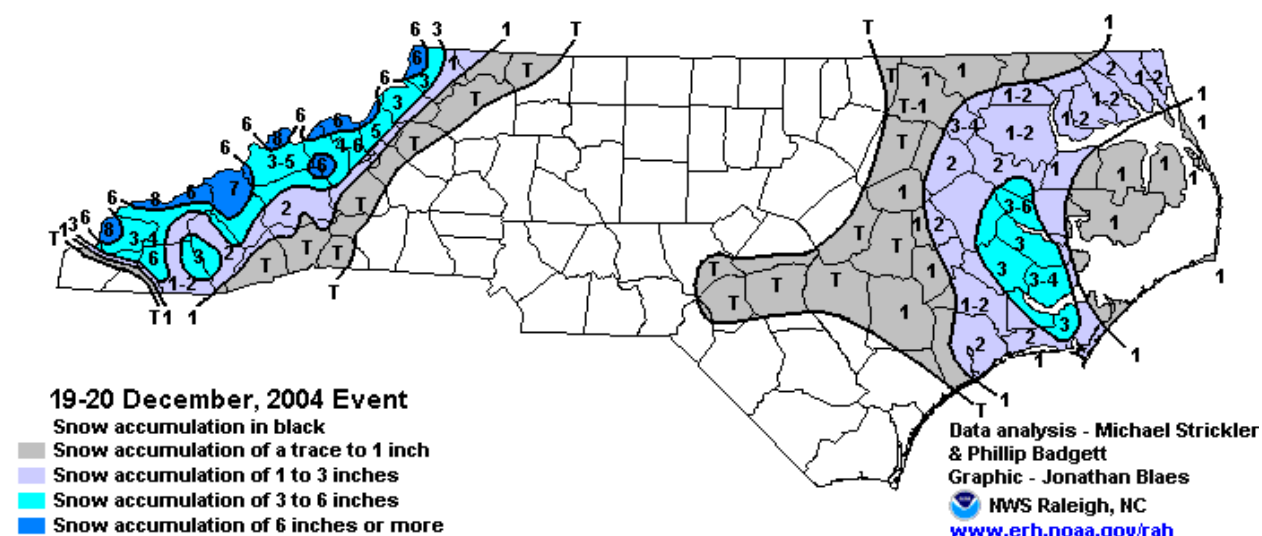


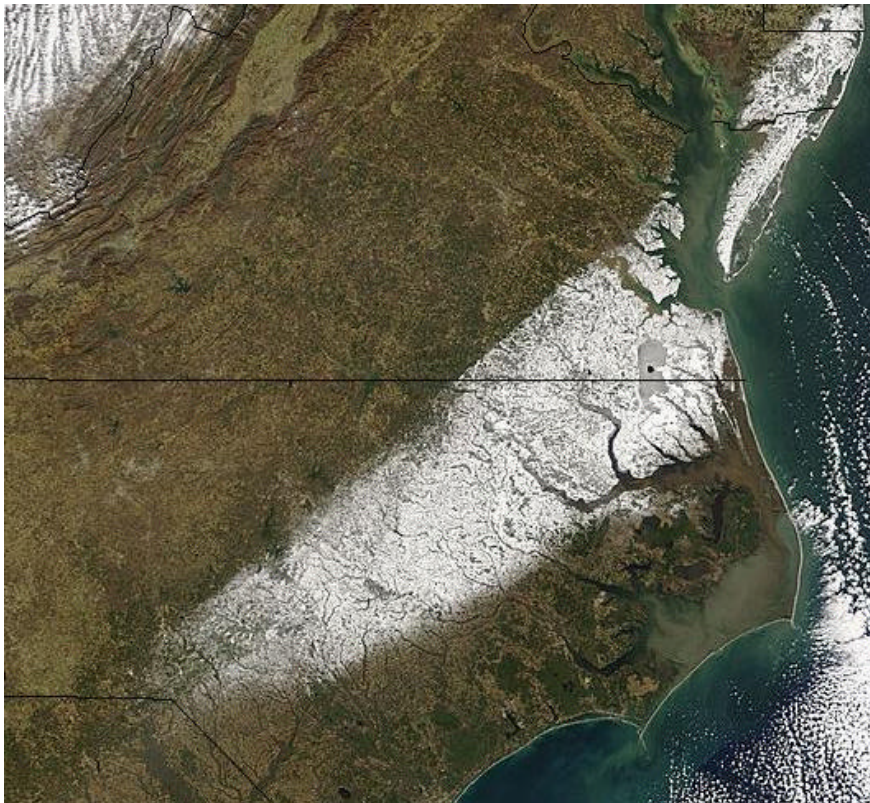
Figure 2 Snowfall accumulations from December 19<sup>th</sup> and 20<sup>th</sup>. Heavy snow fell in the typical northwest upslope flow regions of the N. C. Mountains associated with strong pushes of arctic air. However, the snow that fell so close to the coast and on the Outer Banks was an unusual occurrence.



A brief moderation in temperatures melted most of the season's first snowfall just before the Christmas holiday. Not long after the snow had melted away, the second winter storm of the season produced wintry precipitation across the Coastal Plain and eastern Piedmont on December 26<sup>th</sup>.

The December 26<sup>th</sup> winter storm was again unusual as it brought accumulating snow and sleet over areas east of the climatologically favored. Heavy sleet and snow was limited to areas along and east of a line extending from Rockingham to Sanford, Raleigh, Louisburg, and Halifax. The heaviest ice and snow accumulations extended along the entire length of the Interstate 95 corridor from Lumberton through Fayetteville and Smithfield, to Rocky Mount and Roanoke Rapids. There were so many accidents along portions of the interstate that it had to be closed for long periods of time, creating a massive backup and traffic delays.

This storm was also unusual in that it “split the Triangle area” bringing snow and sleet to the eastern portion of the area (Raleigh in Wake County), while no precipitation fell on the western side (Durham or Chapel Hill in Durham and Orange Counties). The Raleigh-Durham International Airport (located near the Wake and Durham County line) was on the dividing line, and recorded only a small period of snow flurries. Figure 3 is a visible satellite picture from 1200 PM, on December 27<sup>th</sup>, one day after the storm hit. The narrow swath of snow and ice was clearly visible.



**Figure 3 Visible Satellite Image showing the swath of snow/sleet cover at midday on December 27, 2004.**

The snow, sleet, and freezing rain accumulations over North Carolina on December 26<sup>th</sup> are in Figures 4 and 5. The storm summary from this event can be found at:  
<http://www4.ncsu.edu/~nwsfo/storage/cases/20041226/>

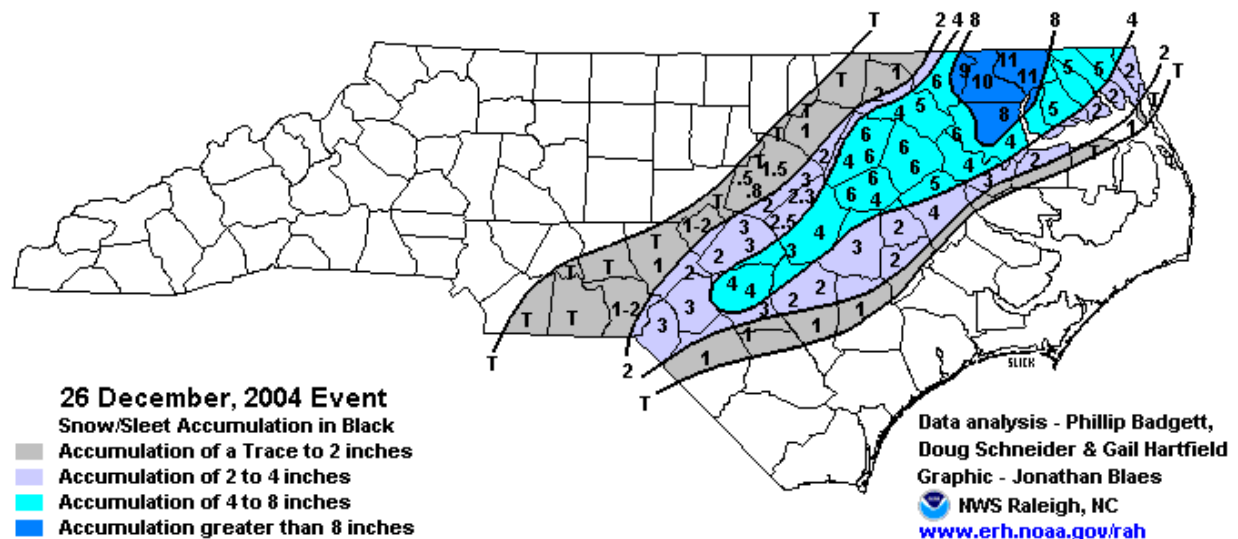


Figure 4 Snow and sleet accumulations associated with the December 26, 2004 winter storm

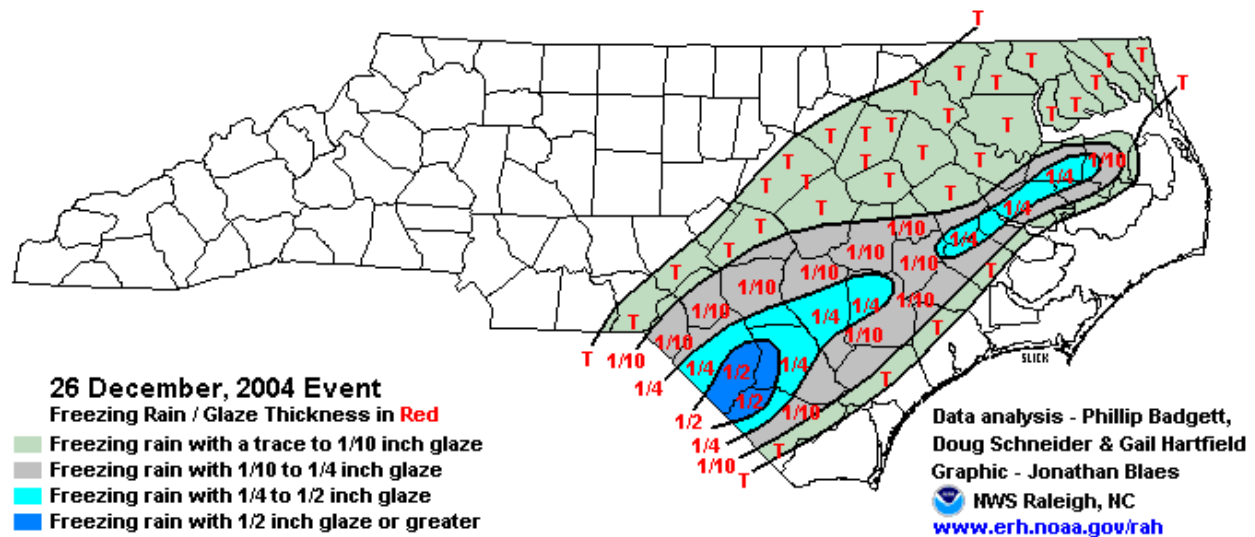
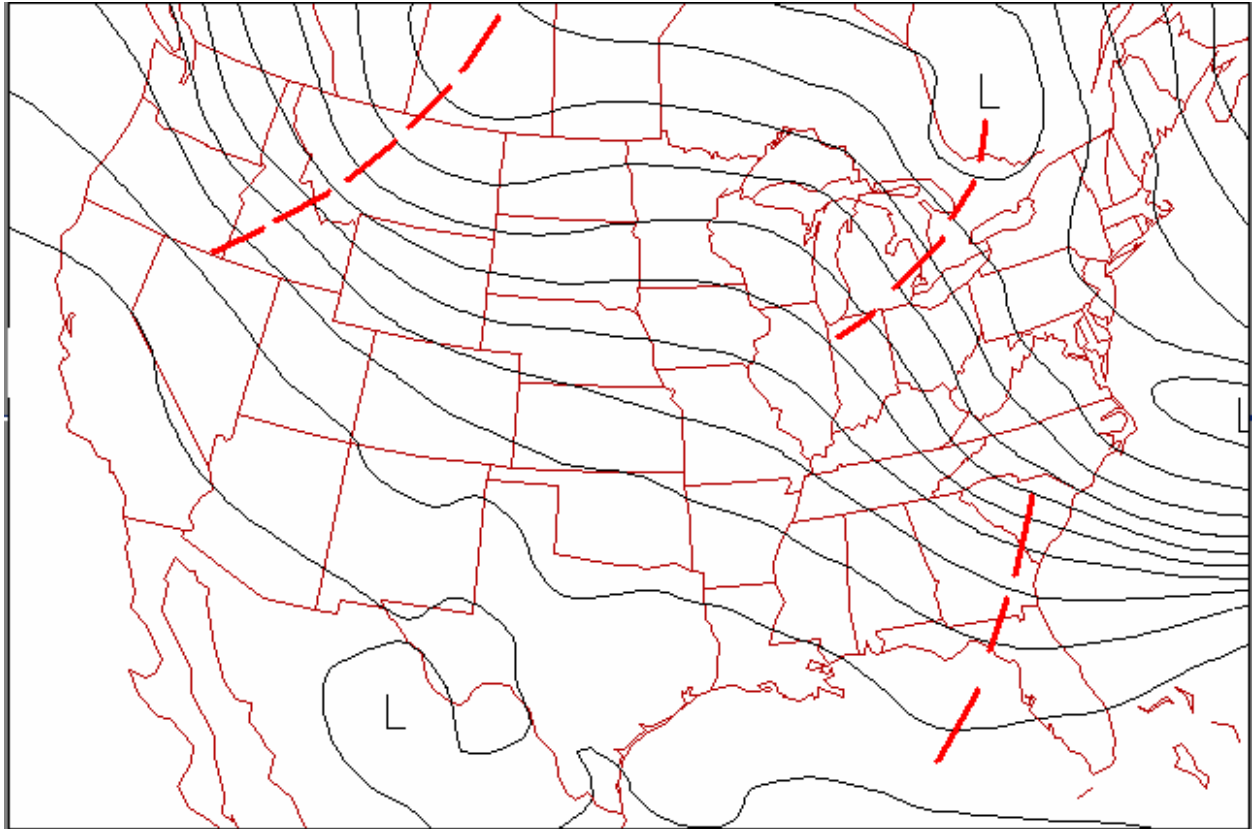


Figure 5 Freezing Rain accrual associate with the December 26, 2004 winter storm

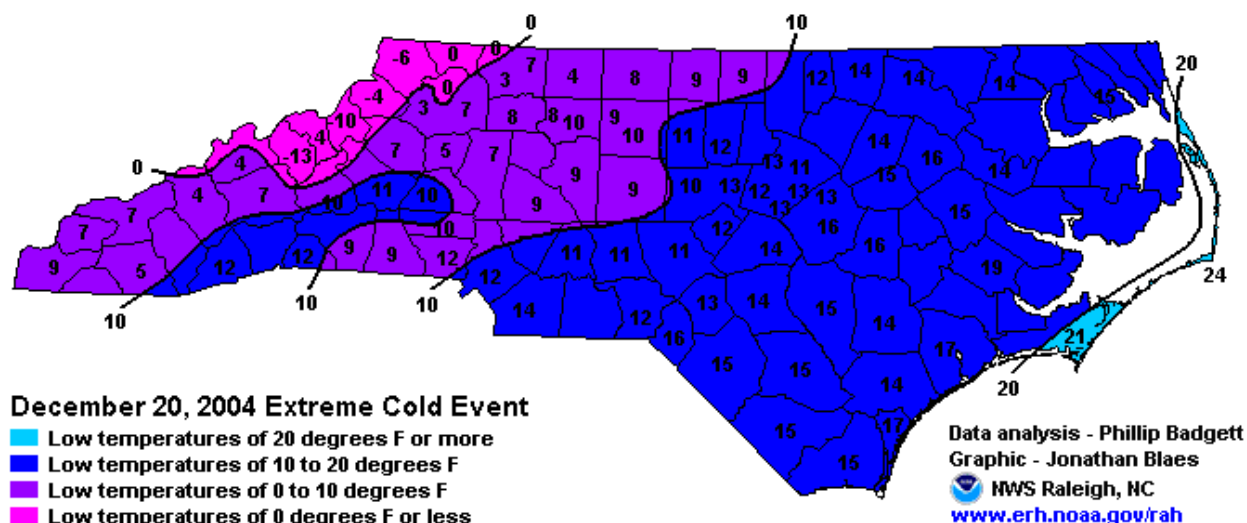
## Temperatures

In addition to the two winter storms, December 2004 will also be remembered for the surges of arctic air that were delivered into the state during the middle and latter half of the month. Figure 6 shows the upper air pattern on the morning of December 20<sup>th</sup>, 2004. This pattern, dominated by a large trough in the eastern United States, allowed arctic air to move deep into the southeastern United States.



**Figure 6 Analyzed Upper Air Pattern observed at 700 AM EST on December 20, 2004. This upper air pattern featured a strong trough over the eastern United States, which allowed cold arctic air to surge deep into the southeastern United States.**

The intense cold was especially noticeable when on December 20<sup>th</sup>, despite sunny skies, high temperatures failed to climb out of the 20s across much of central North Carolina. Low temperatures during this outbreak ranged from 13 below zero to 5 above zero in the mountains, between 5 and 15 degrees across the central part of the state and 15 to 25 degrees across eastern North Carolina and the Outer Banks. These unusually cold temperatures are experienced once every 10 winters on average. Figure 7 shows the low temperatures that were reported on the morning of December 20, 2004.



**Figure 7** Morning low temperatures recorded on December 20, 2004, These temperatures were the coldest readings experienced at some locations since January 1996.

A quick moderation in temperatures arrived on December 22<sup>nd</sup> and 23<sup>rd</sup> as temperatures east of the mountains warmed into the 60s. This warm spell was brief and was followed by another surge of very cold air on the 25<sup>th</sup> and the winter storm on the 26<sup>th</sup>. Although not quite as intense, this air mass was very cold, keeping high temperatures on the 22<sup>nd</sup> and 23<sup>rd</sup> in the 20s across the mountains and the 30s elsewhere. Below normal temperatures persisted through December 29<sup>th</sup>. A dramatic pattern change shut off the delivery of cold air to the eastern states by December 30<sup>th</sup>. A warmer southwesterly flow developed and temperatures reached the 60s on the last day of the month.

Overall, monthly temperatures generally averaged around 1 to 2 degrees below normal statewide. Greensboro and Raleigh-Durham were exceptions with temperatures averaging 0.5 degree above normal. Charlotte averaged 2.4 degrees below normal followed by Elizabeth City (-2.1), Wilmington (-1.8), Hickory (-1.0), Mount Airy (-1.0), Lumberton (-0.5), and Asheville (-0.5) degrees below normal. Figures 8 and 9 depict the daily maximum and minimum temperatures observed during December at Raleigh-Durham and Greensboro.

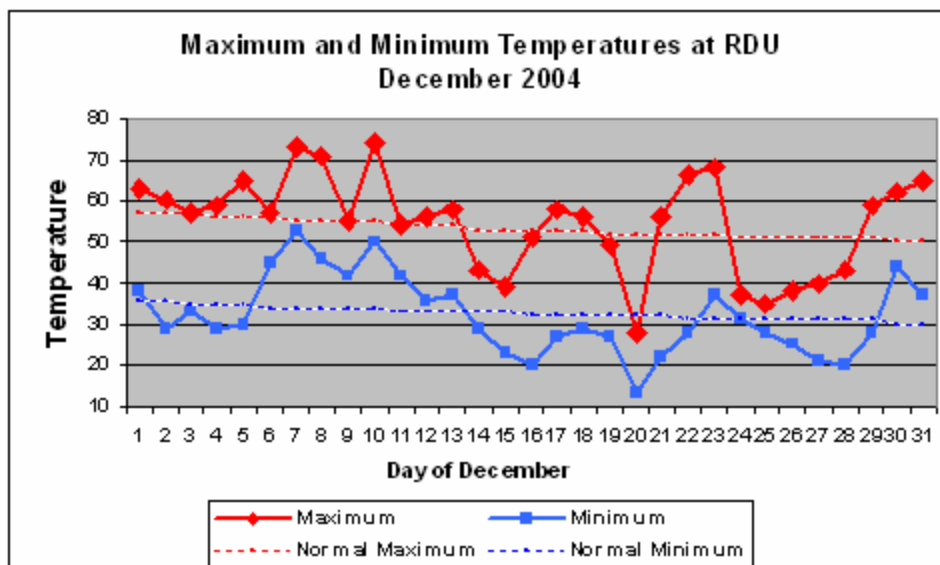


Figure 8 Daily maximum and minimum temperatures observed during December 2004 at Raleigh-Durham (RDU).

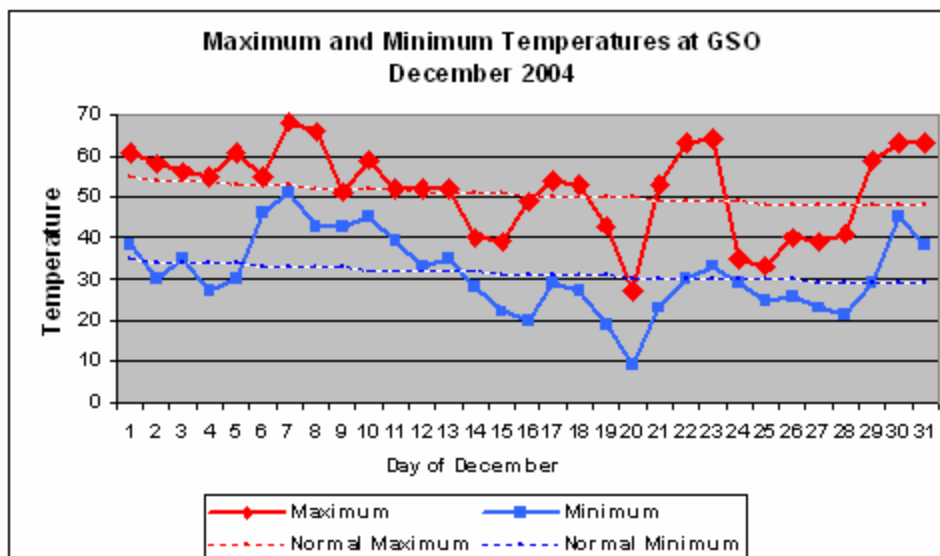


Figure 9 Daily maximum and minimum temperatures observed during December 2004 at Greensboro (GSO).

## Precipitation

Statewide precipitation totals were generally below normal with only one significant rain event (on December 10<sup>th</sup>) and two winter storms that primarily impacted limited portions of the state. Only the southern mountains and foothill locations received precipitation amounts that were near normal. Precipitation totals for the month at selected locations across the state are shown in Figure 10.



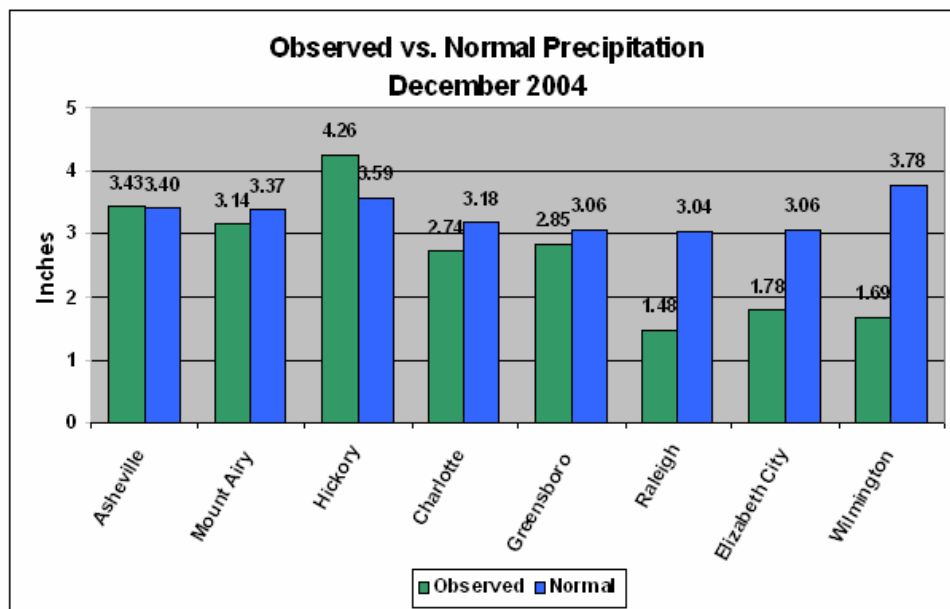


Figure 10 Monthly precipitation totals and normals for December 2004 at selected locations across North Carolina.

A few of the stations in the southern Mountains that recorded near normal precipitation totals include: Brevard (Transylvania County) 6.9 inches, Hickory (Catawba) 4.9 inches, and Hendersonville (Henderson) 4.1 inches. Stations reporting amounts between 75 and 90 percent of normal precipitation include: Statesville (Iredell) 3.8 inches, Greensboro (Guilford) 3.3 inches, Burlington (Alamance) 3.2 inches, and Greenville (Pitt) 2.9 inches. The driest region of the state stretched across the southern Piedmont into the northeast Piedmont and from the Southern Coastal region to the northeast Piedmont. Precipitation amounts were less than 2 inches in these areas (only about 50 percent of normal). Smithfield (Johnston) reported 1.9 inches, Albemarle (Stanly) 1.5 inches, Raleigh-Durham (Wake) 1.5 inches, and Siler City (Chatham) 1.3 inches.

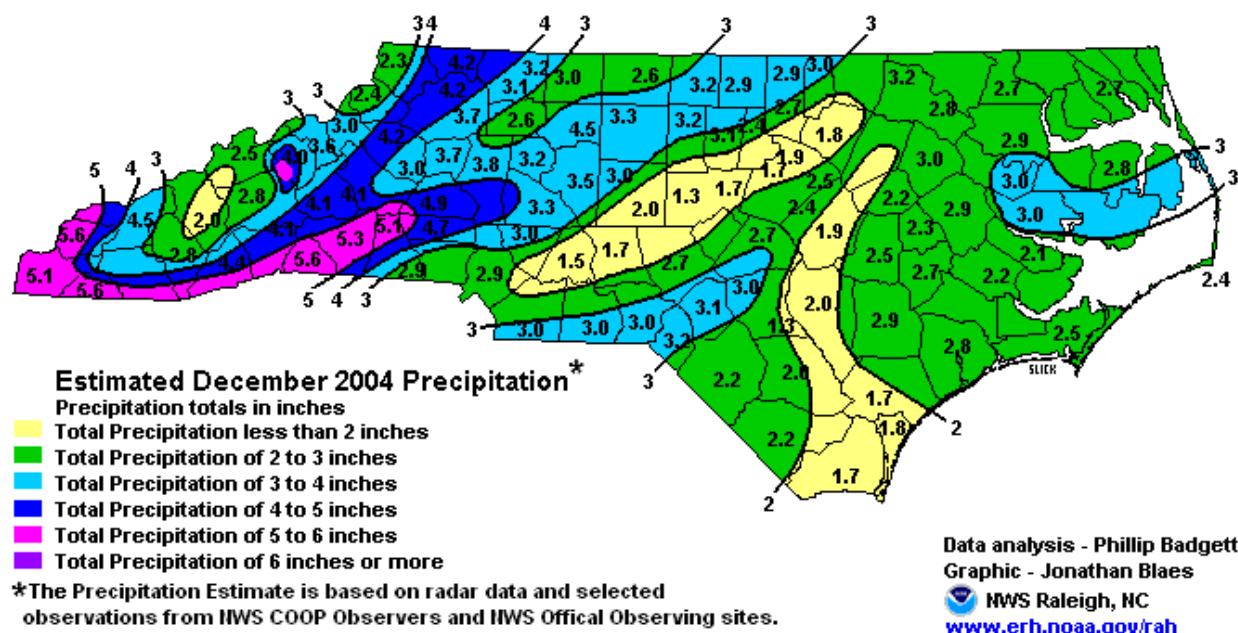


Figure 11: Estimated precipitation totals during December 2004.

## Current, Semi-Annual and Annual Precipitation Trends

The drier than normal December was the opposite of the wet conditions observed in November. The subtropical jet stream that was very active at times in November was rarely a player in the weather across the southeastern United States in December. Four of the past six months at Raleigh have been wetter than normal. As of December 31, 2004, Raleigh had a six month rainfall surplus of 8.28 inches. Much of this surplus came in July and August when an excess of 9.35 inches was recorded. The 12 month (January 2004 through December 2004) precipitation totals show a surplus of 4.00 inches. Figure 12 depicts the monthly precipitation totals at Raleigh-Durham along with the departure from normal.

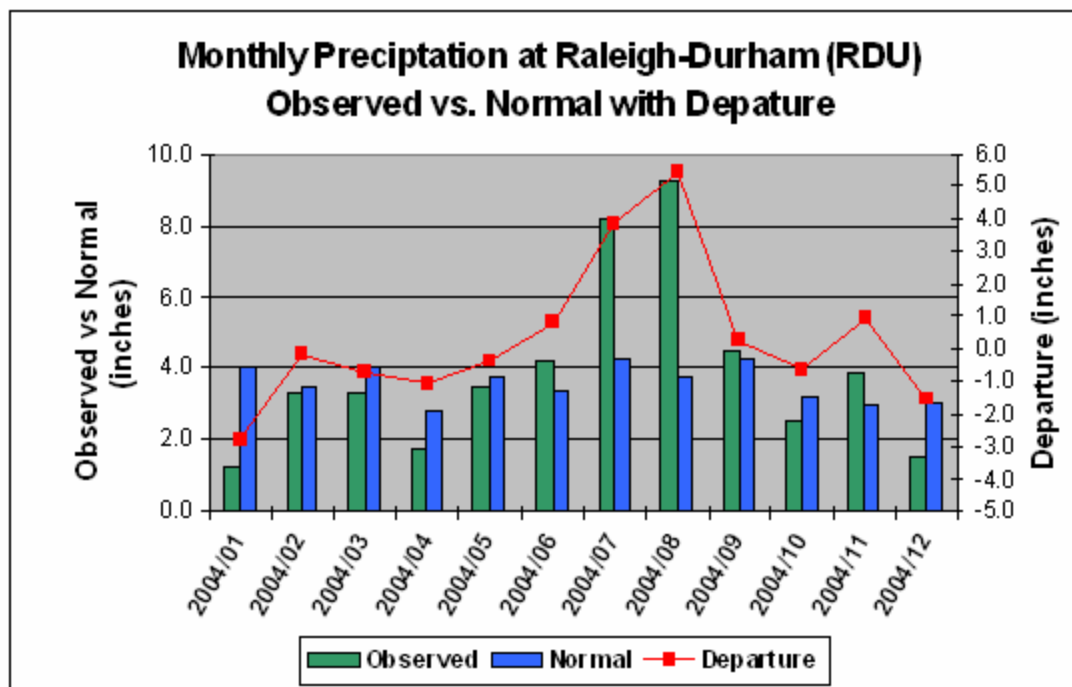


Figure 12 Semi-annual and annual precipitation trends at Raleigh-Durham (RDU).

With a drier than average December, Greensboro continued a rather odd trend of alternating dry and wet months during the past six months. During this six month period, Greensboro had a rainfall surplus of 4.34 inches. Nine of the past twelve months have brought below normal precipitation to Greensboro. As of December 31, the total precipitation during this period (January 2004 through December 2004) was 37.86 inches, which is 5.65 inches below normal. Figure 13 depicts the monthly precipitation totals at Greensboro along with the departure from normal.

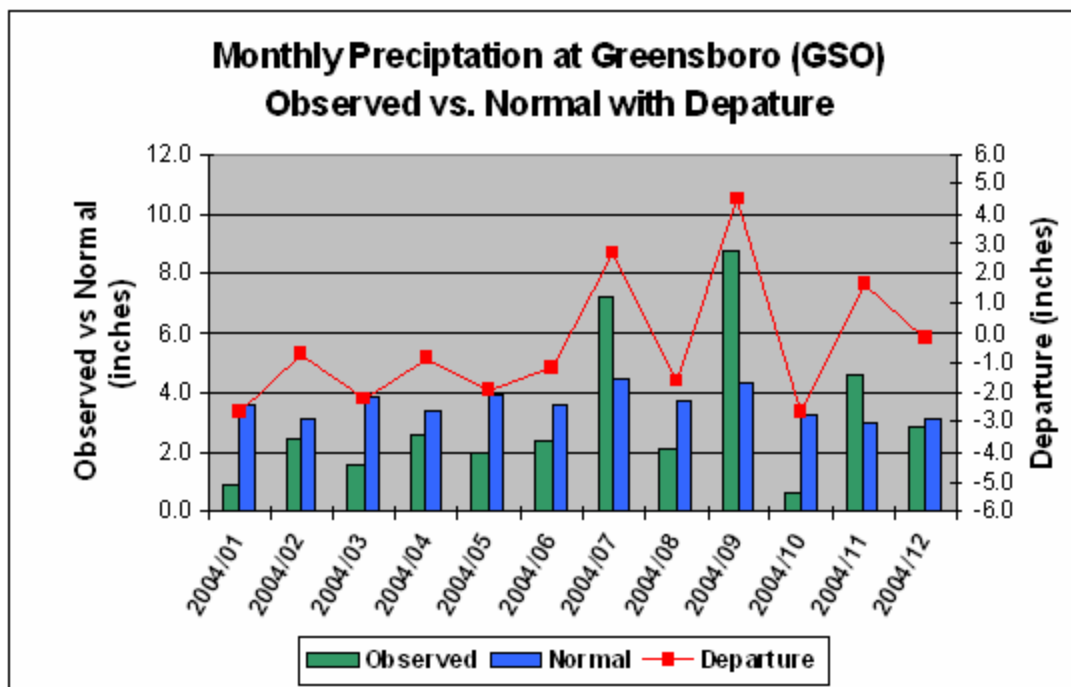


Figure 13 Semi-annual and annual precipitation trends at Greensboro (GSO).

## North Carolina Water Resources Information

The drier than average conditions observed in December was consistent with a recurring theme of dry weather across much of south central and southeastern North Carolina during 2004. The dryness in 2004 extended from the western Piedmont at Wadesboro east through the northern Piedmont around Greensboro then southeast through the Sandhills to the Outer Banks. This area encompassed Fayetteville, Goldsboro, Lumberton, Wilmington, and Cape Hatteras. Fayetteville (Cumberland County) seemed to be in the center of the dryness, recording below normal precipitation during 11 of the 12 months in 2004. During this period, the precipitation deficit at Fayetteville reached 12.99 inches. Other stations recording a very dry year in 2004 included: Albemarle (Stanly), 41.4 inches (7.5 inches below normal) ; Cartage (Moore), 39.40 inches (9.4 inches below normal) ; Lumberton (Robeson), 39.77 inches (8.21 inches below normal); Wilmington (New Hanover), 50.74 inches (6.33 inches below normal); and Cape Hatteras (Outer Banks Dare), 38.50 inches (19.9 inches below normal).

The dry weather across southern North Carolina during 2004 was beginning to show visibly in late December. Water levels in many farm ponds across Albemarle, Troy, and Carthage had dropped several feet below full pool. For drought monitor information refer to the following web site: <http://www.drought.unl.edu/dm/monitor.html>

In stark contrast, 2004 brought a precipitation surplus across much of western and northern North Carolina. Some locations in the Mountains, Foothills, and Piedmont received a surplus of 5 to 18 inches of rain during the active Atlantic tropical season. The southern Mountains, which received devastating flooding from some of the tropical systems in August, recorded a 2004 rainfall surplus between 15 and 18 inches. Stations recording a wet year included: Brevard (Transylvania), 84.3 inches (17.9 inches above normal); Mount Mitchell (Yancey), 78.70 inches (4 inches above normal); Tryon (Polk), 69.60 inches (4 inches above normal); Boone (Watauga), 55.40 inches (3.7 inches above normal); Dobson (Surry), 59.55 inches (10 inches above normal); Morganton (Burke), 55.80 inches (6.1 inches above normal); Graham (Alamance), 47.70 inches (2 inches above normal); and Arcola (Warren), 50.0 inches (2.3 inches above normal).

Observed and normal precipitation totals during the 2004 calendar year, at several locations across North Carolina, are shown in Figure 14.

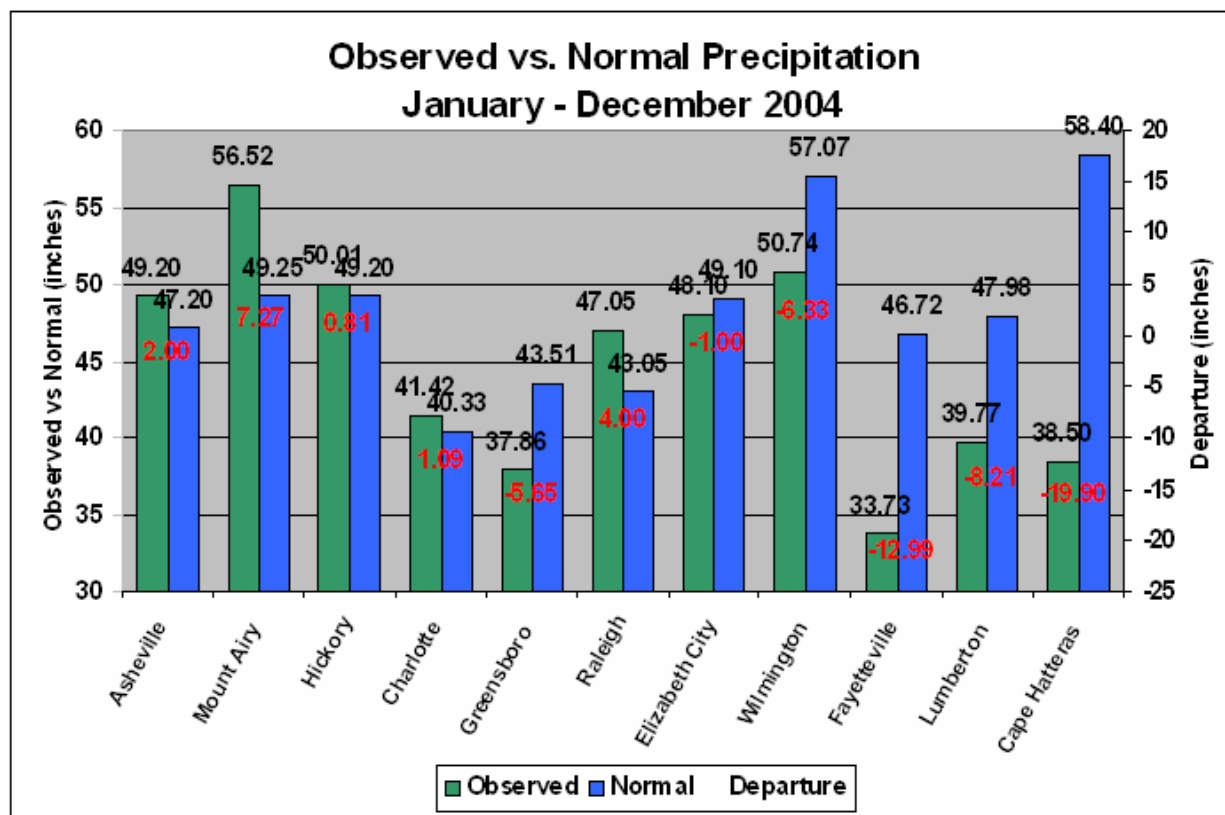


Figure 14: Observed and normal precipitation totals for the 2004 calendar year at locations across North Carolina.

## NC Weather Review Team

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